

Supplementary Online Content

Wen H, Soni A, Hollingsworth A, et al. Association between Medicaid expansion and rates of opioid-related hospital use. *JAMA Intern Med*. Published online March 23, 2020. doi:10.1001/jamainternmed.2020.0473

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This supplementary material has been provided by the authors to give readers additional information about their work.

eMethods. Variable Measurement and Model Specification

$$\ln(\text{OpInps}_{s,t}) = \beta_0 + \beta_1 \text{Post2014Exp}_s \times \text{Post2014Exp}_t + \beta_2 \text{Pre2014Exp}_s \times \text{Pre2014Exp}_t + \beta_3 X_{s,t} + \rho_s + \tau_t + \varepsilon_{s,t}$$

$$\ln(\text{OpInps}_{s,t}) = \beta_0 + \beta_1 \text{Post2014Exp}_s \times \text{HighDATADocs} \times \text{Post2014Exp}_t + \beta_2 \text{Post2014Exp}_s \times \text{Post2014Exp}_t + \beta_3 \text{Pre2014Exp}_s \times \text{HighDATADocs} \times \text{Pre2014Exp}_t + \beta_4 \text{Pre2014Exp}_s \times \text{Pre2014Exp}_t + \beta_5 \text{DATADocs}_{s,t} + \beta_6 X_{s,t} + \rho_s + \tau_t + \varepsilon_{s,t}$$

$$\ln(\text{OpED}_{s,t}) = \beta_0 + \beta_1 \text{Post2014Exp}_s \times \text{Post2014Exp}_t + \beta_2 \text{Pre2014Exp}_s \times \text{Pre2014Exp}_t + \beta_3 X_{s,t} + \rho_s + \tau_t + \varepsilon_{s,t}$$

$$\ln(\text{OpED}_{s,t}) = \beta_0 + \beta_1 \text{Post2014Exp}_s \times \text{HighDATADocs} \times \text{Post2014Exp}_t + \beta_2 \text{Post2014Exp}_s \times \text{Post2014Exp}_t + \beta_3 \text{Pre2014Exp}_s \times \text{HighDATADocs} \times \text{Pre2014Exp}_t + \beta_4 \text{Pre2014Exp}_s \times \text{Pre2014Exp}_t + \beta_5 \text{DATADocs}_{s,t} + \beta_6 X_{s,t} + \rho_s + \tau_t + \varepsilon_{s,t}$$

NOTES:

s: state, excluding Alabama, Delaware, Idaho, and New Hampshire due to the state data unavailable in the Healthcare Cost and Utilization Project (HCUP) 2005-2017 state inpatient and ED data;

In addition to Alabama, Delaware, Idaho, and New Hampshire, ED data were also missing in Alaska, Colorado, Louisiana, Michigan, Mississippi, Montana, New Mexico, Oklahoma, Oregon, Virginia, Washington, and West Virginia; thus we excluded these states from the ED analyses;

Furthermore, payer data were missing in Connecticut, District of Columbia, Hawaii, Iowa (inpatient data only), North Dakota, South Dakota, and Wyoming, and contained coding errors (e.g., misclassification of Medicaid managed care as private insurance) in Nebraska, New York (ED data only), and Vermont; thus we excluded these states from the payer share analyses;

t: year-quarter, ranging from the first quarter of 2005 to the last quarter of 2017;

$\ln(\text{OpInps}_{s,t})$ and $\ln(\text{OpED}_{s,t})$: logarithmic-transformed rate of opioid-related hospital discharges and emergency department (ED) discharges per 100,000 state population; the logarithmic-transformation is commonly used to transform right-skewed outcomes to approximately conform to normality; the estimates provided us with the percentage changes of the outcome;

The opioid-related hospital and ED discharge data were derived from the HCUP State Inpatient Databases (SID) and State Emergency Department Databases (SEDD), which contained the universe of the hospital encounter abstracts and emergency department encounter abstracts from hospital-affiliated emergency departments in the participating HCUP States and were translated into a uniform format to facilitate multistate comparisons and analyses. Types of hospitals included in SID and SEDD are community hospitals, defined as short-term, non-Federal, general, and other hospitals, excluding hospital units of other institutions (e.g., prisons); community hospitals include obstetrics and gynecology, otolaryngology, orthopedic, cancer, pediatric, public, and academic medical hospitals; long-term care facilities such as rehabilitation, psychiatric, and substance abuse treatment hospitals were excluded; however, if a patient received long-term care, rehabilitation, or treatment for a psychiatric or substance abuse condition in a community hospital, the discharge record for that stay was included;

Opioid-related diagnoses, including opioid abuse, dependence, and overdose, were identified by the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) diagnostic codes: 304.00-304.02: Opioid type dependence (unspecified; continuous; episodic); 304.70-304.72: Combinations of opioid type drug with any other drug dependence (unspecified; continuous; episodic); 305.50-305.52: Opioid abuse (unspecified; continuous; episodic); 965.00-965.02; 965.09: Poisoning by opium (alkaloids), unspecified; heroin; methadone; other opiates and related narcotics; 970.1: Poisoning by opiate antagonists;

E850.0-E850.2: Accidental poisoning by heroin; methadone; other opiates and related narcotics; E935.0-E935.2: Heroin, methadone, other opiates and related narcotics causing adverse effects in therapeutic use; E940.1: Opiate antagonists causing adverse effects in therapeutic use; opioid-related diagnoses were also identified by the International Classification of Diseases, 10th Revision, Clinical Modification (ICD-10-CM) diagnostic codes: F11 series: Opioid-related disorders, excluding F11.21; T40 series: Poisoning by, adverse effect of, and underdosing of narcotics and psychodysleptics, including poisoning accidental, undetermined, and adverse effect, with a seventh digit indicating initial, subsequent encounter, sequela: Opium 0X1, 0X4, 0X5, Heroin 1X1, 1X4, Other opioids 2X1, 2X4, 2X5, Methadone 3X1, 3X4, 3X5, Other synthetic narcotics 4X1, 4X4, 4X5, Unspecified narcotics 601, 604, 605, Other narcotics 691, 694, 695;

Data Source: Agency for Healthcare Research and Quality (AHRQ). Healthcare Cost and Utilization Project (HCUP) Opioid-Related Hospital Use:

<https://www.hcup-us.ahrq.gov/faststats/OpioidUseServlet>;

Post2014Exp_s × Post2014Exp_t: difference-in-differences indicator for state implementation of Medicaid expansions in 2014 under the Affordable Care Act (ACA) State Plan Amendments provision or the Section 1115 waiver;

Data Source: authors' tracking and analysis of state legislative and executive activity;

Henry J. Kaiser Family Foundation (KFF). Status of state action on the Medicaid expansion decision: <http://www.kff.org/health-reform/state-indicator/state-activity-around-expanding-medicaid-under-the-affordable-care-act/>

Pre2014Exp_s × Pre2014Exp_t: difference-in-differences indicator for state implementation of Medicaid expansions between 2011 and 2010 under the Health Insurance Flexibility and Accountability (HIFA) initiative or the early adoption provision of the ACA;

Data Source: authors' tracking and analysis of state legislative and executive activity;

Atherly A, Dowd BE, Coulam RF, Guy G. The effect of HIFA waiver expansions on uninsurance rates in adult populations. *Health Serv Res.* 2012 Jun 1;47(3pt1):939-62;

Coughlin TA, Long SK, Graves JA, Yemane A. An early look at ten state HIFA Medicaid waivers. *Health Aff (Millwood).* 2006 May;25(3):w204-16;

Wen H, Druss BG, Cummings JR. Effect of Medicaid Expansions on Health Insurance Coverage and Access to Care among Low-Income Adults with Behavioral Health Conditions. *Health Serv Res.* 2015 Dec 1;50(6):1787-809;

Sommers BD, Kenney GM, Epstein AM. New evidence on the Affordable Care Act: coverage impacts of early Medicaid expansions. *Health Aff (Millwood).* 2014 Jan 1;33(1):78-87;

HighDATA_{Docs}: high capacity for opioid use disorder treatment were determined based on the per-capita number of DATA-waivered physicians during the post-expansion periods compared to the national average during the same periods; we used (1) the simple total of 100-patient-waived physicians and 30-patient-waived physicians per 100,000 state population, (2) the weighted total of the 100-patient-waived physicians and 30-patient-waived physicians per 100,000 state population by patient limits, both resulting in the same categorization of high/low buprenorphine prescribing capacity;

Data Source: Substance Abuse and Mental Health Services Administration (SAMHSA): Number of DATA-waived practitioners newly certified per year: <https://www.samhsa.gov/medication-assisted-treatment/physician-program-data/certified-physicians>;

DATA_{Docs,t}: weighted total of the 100-patient-waived physicians and 30-patient-waived physicians per 100,000 state population by patient limits;

Data Source: Substance Abuse and Mental Health Services Administration (SAMHSA): Number of DATA-waived practitioners newly certified per year: <https://www.samhsa.gov/medication-assisted-treatment/physician-program-data/certified-physicians>;

$X_{s,t}$: a time-varying, state-level vector of overall hospital capacity, general economic conditions, and concurrent policies that may have been correlated with opioid-related inpatient rates and with state decisions on Medicaid expansions, including:

$Bed_{s,t}$: number of staffed beds for community hospitals, which represent 85% of all hospitals, per 1,000 state population, for each state/year. Federal hospitals, long term care hospitals, psychiatric hospitals, institutions for the intellectually disabled, and alcoholism and other chemical dependency hospitals are not included;

Data Source: Health Forum, LLC, an affiliate of the American Hospital Association (AHA). AHA Annual Survey: <http://www.ahaonlinestore.com/ProductDisplay.asp?ProductID=637>;

$Pov_{s,t}$: poverty rate calculated for the civilian noninstitutionalized population based on household income, household size, and household composition, relative to a set of dollar value thresholds called the “federal poverty level (FPL)”;

Data Source: Health Resources and Services Administration (HRSA). Area Health Resources Files (AHRF): <https://datawarehouse.hrsa.gov/topics/ahrf.aspx>;

$Unemp_{s,t}$: unemployment rate calculated as the number of unemployed persons divided by the number of persons in the labor force (aged 16 and above); the numerator and denominator excluding the institutionalized persons or those without employment who are not seeking employment;

Data Source: Health Resources and Services Administration (HRSA). Area Health Resources Files (AHRF): <https://datawarehouse.hrsa.gov/topics/ahrf.aspx>;

$PDMPEst_s \times PDMPEst_t$ and $PDMPMdt_s \times PDMPMdt_t$: concurrent policy indicators for establishment of statewide prescription drug monitoring programs (PDMPs) and implementation of comprehensive PDMP mandates;

Data Source: National Alliance for Model State Drug Laws (NAMSDL). Prescription drug monitoring programs: <http://www.namsdl.org/prescription-monitoring-programs.cfm>;

$PainLaws_s \times PainLaw_t$: concurrent policy indicator for state regulations on pain management clinics;

Data Source: Centers for Disease Control and Prevention (CDC) Public Health Law Program. State laws on prescription drug misuse and abuse: <https://www.cdc.gov/phlp/publications/topic/prescription.html>;

$GoodSams_s \times GoodSam_t$: concurrent policy indicator for state implementation of Good Samaritan laws;

Data Source: authors’ tracking and analysis of state legislative and executive activity;

Rees DI, Sabia JJ, Argys LM, Latshaw J, Dave D. With a little help from my friends: The effects of naloxone access and Good Samaritan laws on opioid-related deaths. National Bureau of Economic Research; 2017 Feb 16: NBER Working Paper No. 23171;

$NalAccs_s \times NalAcc_t$: concurrent policy indicator for state implementation of naloxone access laws;

Data Source: authors’ tracking and analysis of state legislative and executive activity;

Rees DI, Sabia JJ, Argys LM, Latshaw J, Dave D. With a little help from my friends: The effects of naloxone access and Good Samaritan laws on opioid-related deaths. National Bureau of Economic Research; 2017 Feb 16: NBER Working Paper No. 23171;

$MedMrjs_s \times MedMrj_t$, $MedDisps_s \times MedDisp_t$, $RecMrjs_s \times RecMrj_t$, and $RecDisps_s \times RecDisp_t$: difference-in-differences indicator for state implementation of medical marijuana laws that permit marijuana use for medical use and the operation of the first medical marijuana dispensaries, as well as state implementation of recreational marijuana laws that permit marijuana use for adult use and the operation of the first recreational marijuana dispensaries;

Data Source: National Conference of State Legislation (NCSL). Marijuana deep dive: <http://www.ncsl.org/bootore/state-legislatures-magazine/marijuana-deep-dive.aspx>;

Bradford AC, Bradford WD. Medical marijuana laws may be associated with a decline in the number of prescriptions for Medicaid enrollees. *Health Affairs (Millwood)*. 2017 May 1;36(5):945-51;

Powell D, Pacula RL, Jacobson M. Do medical marijuana laws reduce addictions and deaths related to pain killers?. *National Bureau of Economic Research Working Paper Series*. No. w21345. 2015 Jul 10;

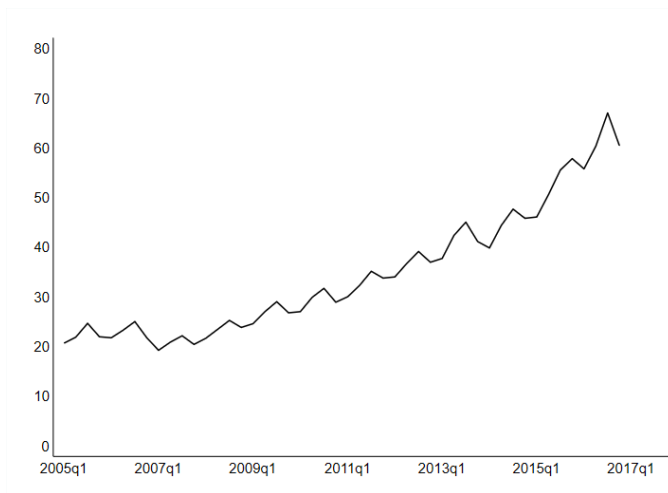
ρ_s : state fixed effects, τ_t : year-quarter fixed effects; the two-way fixed effects account for the time-invariant state heterogeneity and the national secular trend that may have been correlated with opioid-related inpatient rates and with state decisions on Medicaid expansions;

All models were population-weighted and were state-clustered to correct for the within-state serial correlation in error terms using Stata/SE Version 15 “`aweight`” and “`cluster`” command;

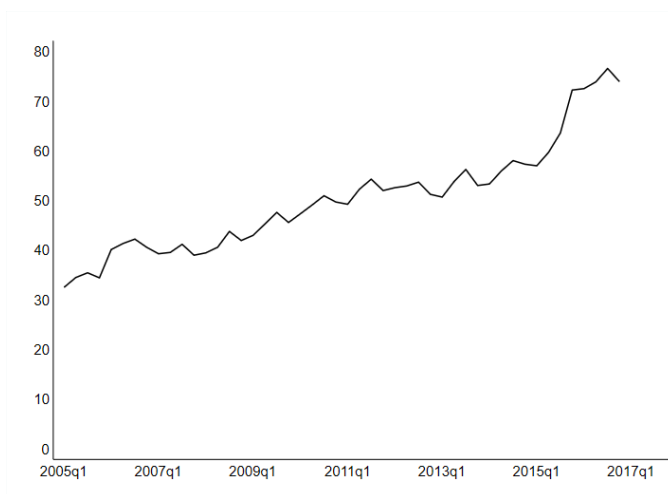
Baseline values and marginal effects were estimated using Stata/SE Version 15 “`margins`” command; the baseline (i.e., non-expansion states/pre-expansion periods) values were calculated by setting $Post2014Exp_s=0$, $Post2014Exp_t=0$, $Pre2014Exp_s=0$, $Pre2014Exp_t=0$; the marginal effects of post-2014 expansion and pre-2014 expansion corresponded to the changes in outcome when $Post2014Exp_s$ and $Post2014Exp_t$ change from 0 to 1 and $Pre2014Exp_s$ and $Pre2014Exp_t$ change from 0 to 1, respectively.

eFigure 1. Opioid-Related Hospital Events per Quarter

Panel A: Quarterly Rate of Opioid-Related ED Visits per 100,000 Population in the United States



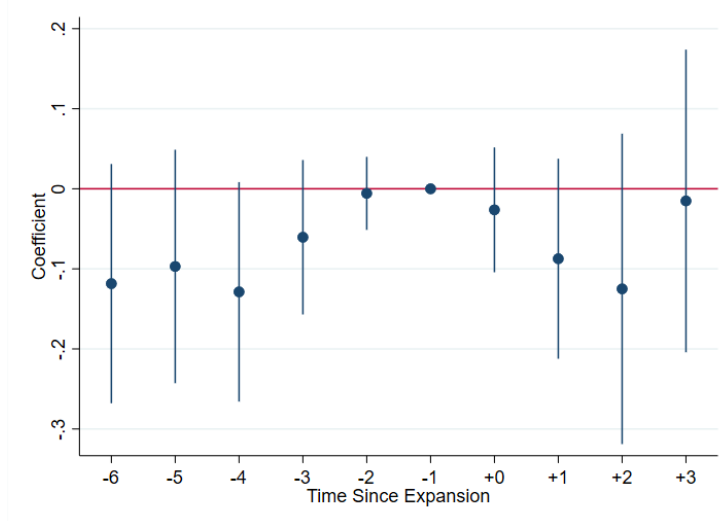
Panel B: Quarterly Rate of Opioid-Related Inpatient Hospitalizations per 100,000 Population in the United States



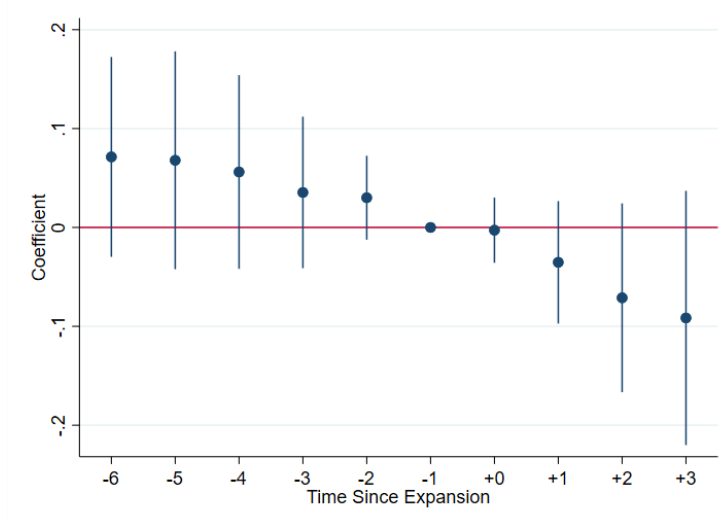
SOURCE: Authors' calculations based on HCUP FastStats 2005-17. Figures display the nation-wide number of hospital events per 100,000 population in each quarter.

eFigure 2. Event Study Regression Results

Panel A: Annual Changes in Opioid-Related ED Visits Per 100,000 Population for Expansion versus Non-Expansion States, Relative to Baseline (1 Year Pre-Expansion)



Panel B: Annual Changes in Opioid-Related Inpatient Hospitalizations Per 100,000 Population for Expansion versus Non-Expansion States, Relative to Baseline (1 Year Pre-Expansion)



SOURCE:

Authors' analysis of the Healthcare Cost and Utilization Project (HCUP) inpatient and emergency department data 2005-2017.

NOTES:

Figure displays point estimates and state-clustered 95 percent confidence intervals for the estimated percent change in hospital events per 100,000 population in Medicaid expansion versus non-expansion states, relative to the baseline year (i.e. one year before expansion). All regressions also control for covariates described in eMethods.

eTable 1. Summary of State Implementation of Medicaid Expansions for Adult Population, 2005-2017

POST-2014 MEDICAID EXPANSIONS		<i>Expansion State</i>	<i>Effective Date</i>	<i>Treatment Capacity^a</i>
State Plan Amendment (SPA) (25 States and DC)		CA, CT, DE ^{bc} , DC, KY, MD, MA, NJ, NM, NY, OH, OR ^c , RI, VT, WA ^c , WV ^c	2014/01	High
		AZ, CO ^c , HI, IL, MN, ND, NV	2014/01	Low
		PA	2015/01	High
		AK ^c	2015/09	High
		LA ^c	2016/07	High
Section §1115-Waiver (6 States)		AR	2014/01	Low
		IA	2014/01	Low
		MI ^c	2014/04	High
		NH ^{bc}	2014/08	High
		IN	2015/02	Low
		MT ^c	2016/01	Low
PRE-2014 MEDICAID EXPANSIONS		<i>Partial Expansion State</i>	<i>Effective Date</i>	<i>Treatment Capacity^a</i>
Health Insurance Flexibility and Accountability (HIFA)-Waiver ^d (10 States)		IA	2005/07	Low
		ID ^{bc}	2005/07	Low
		NM	2005/12	High
		OK ^c	2005/12	Low
		AR	2007/01	Low
		MA	2007/05	High
		VT	2007/10	High
		IN ^e	2008/01	Low
		WI ^e	2008/02	Low
		MD	2010/01	High
Early-Adopter ^f (2 States and DC)		DC	2010/07	High
		MN	2011/03	High
		CA	2011/07	High

SOURCES:

Data based on authors' tracking and analysis of state legislative and executive activity;

Other references include:

For SPA & §1115-waiver expansions:

Henry J. Kaiser Family Foundation (KFF). Status of state action on the Medicaid expansion decision: <http://www.kff.org/health-reform/state-indicator/state-activity-around-expanding-medicare-under-the-affordable-care-act/>

For HIFA-waiver expansions:

Atherly A, Dowd BE, Coulam RF, Guy G. The effect of HIFA waiver expansions on uninsurance rates in adult populations. *Health Serv Res.* 2012 Jun 1;47(3pt1):939-62.

Coughlin TA, Long SK, Graves JA, Yemane A. An early look at ten state HIFA Medicaid waivers. *Health Aff (Millwood).* 2006 May;25(3):w204-16.

Henry J. Kaiser Family Foundation (KFF). A look at Section 1115 Medicaid demonstration waivers under the ACA: A focus on childless adults: <https://www.kff.org/medicaid/issue-brief/a-look-at-section-1115-medicaid-demonstration-waivers-under-the-aca-a-focus-on-childless-adults/>

Wen H, Druss BG, Cummings JR. Effect of Medicaid Expansions on Health Insurance Coverage and Access to Care among Low-Income Adults with Behavioral Health Conditions. *Health Serv Res.* 2015 Dec 1;50(6):1787-809.

For early-adopter expansions:

Sommers BD, Kenney GM, Epstein AM. New evidence on the Affordable Care Act: coverage impacts of early Medicaid expansions. *Health Aff (Millwood).* 2014 Jan 1;33(1):78-87.

NOTES:

a. High/low capacity for opioid disorder treatment was determined based on the per-capita number of DATA-waivered physicians during the post-expansion periods comparing to the national average during the same periods; we used (1) the simple total of 30- and 100-patient limits physicians, (2) the weighted total of 30- and 100-patient limits physicians by patient limits, both resulting in the same categorization of high/low buprenorphine treatment capacity;

b. States were excluded from the inpatient analysis due to the state data being unavailable in the Healthcare Cost and Utilization Project (HCUP) 2005-2017 inpatient data;

c. States were excluded from the emergency department (ED) analysis due to the state data being unavailable in the Healthcare Cost and Utilization Project (HCUP) 2005-2017 ED data;

d. Notable exclusions from HIFA-waiver states: CO (2002/10), IL (2002/10), NJ (2003/03), VA (2005/08), and NV (2006/12), which targeted children, pregnant women, and a limited number of parents and caregivers of the State Children's Health Insurance Program (CHIP)-eligible children;

e. HIFA-waiver expansions have been closed in IN (since 2009) and WI (since 2011);

f. Notable exclusions from early-adopter states: WA (2011/01) and NJ (2011/04), which moved adult enrollees from tailored state-funded programs to relatively comprehensive, standard Medicaid programs, rather than expanding coverage to previously uninsured adults.

eTable 2. Association between Medicaid Expansion and Opioid-Related Inpatient Hospitalizations: High vs Low Treatment Capacity States §

PERCENT CHANGE %				
	(1) POST-2014 HIGH CAPACITY	(2) PRE-2014 HIGH CAPACITY	(3) POST-2014 LOW CAPACITY	(4) PRE-2014 LOW CAPACITY
<i>Opioid-Related Inpatient Rate</i>	-10.73*	-6.66*	-7.68	-2.69
<i>(per 100,000 population per quarter)</i>	[-20.72, -0.74]	[-12.00, -1.32]	[-22.17, 6.80]	[-8.24, 13.63]

SOURCE:

Authors' analysis of the Healthcare Cost and Utilization Project (HCUP) inpatient data 2005-2017.

NOTES:

* $p < 0.05$, 95% confidence intervals in brackets clustered at the state level;

§ High/low capacity for opioid use disorder treatment was determined based on the per-capita number of DATA-waivered physicians during the post-expansion periods comparing to the national average during the same periods.

eTable 3. Association between Medicaid Expansion and Opioid-Related Inpatient Hospitalizations: High vs. Low Treatment Capacity States (alternative categorization) §

PERCENT CHANGE %				
	(1) POST-2014 HIGH CAPACITY	(2) PRE-2014 HIGH CAPACITY	(3) POST-2014 LOW CAPACITY	(4) PRE-2014 LOW CAPACITY
<i>Opioid-Related Inpatient Rate</i>	-16.87**	-7.89**	2.21	3.54
<i>(per 100,000 population per quarter)</i>	[-26.74, -6.99]	[-13.00, -2.78]	[-6.08, 10.50]	[-4.09, 11.17]

SOURCE:

Authors' analysis of the Healthcare Cost and Utilization Project (HCUP) inpatient data 2005-2017.

NOTES:

** $p < 0.01$; 95% confidence intervals in brackets clustered at the state level;

§ High/low capacity for opioid use disorder treatment was determined based on the per-capita number of specialty substance use disorder treatment facilities that provided medication-assisted treatment with buprenorphine, methadone, and/or naltrexone during the post-expansion periods comparing to the national average during the same periods.

eTable 4. Association between Medicaid Expansion and Opioid-Related Inpatient Hospitalizations

	(1) WITHOUT EXPANSION (QUARTERLY RATE PER 100,000 POPULATION)	(2) WITH POST-2014 EXPANSIONS (PERCENT CHANGE)	(3) WITH PRE-2014 EXPANSIONS (PERCENT CHANGE)
<u>All</u>	47.12	-9.74*	-3.91
		[-18.83, -0.65]	[-9.16, 1.33]
<u>By Sex</u>			
~ Female	46.31	-9.16*	-3.96
		[-18.20, -0.11]	[-9.20, 1.27]
~ Male	48.03	-10.04*	-3.64
		[-19.45, -0.63]	[-9.36, 2.09]
<u>By Age Categories</u>			
~ Age <25	14.86	-0.72	1.69
		[-10.86, 9.42]	[-5.65, 9.03]
~ Age 25~44	66.93	-13.01*	-6.72*
		[-24.67, -1.34]	[12.78, -0.65]
~ Age 45~64	67.99	-11.89*	-5.17†
		[-21.55, -2.22]	[-11.14, 0.80]
~ Age ≥65	50.83	-3.79	-0.56
		[-15.76, 8.18]	[-7.53, 8.67]
<u>By Community-Level Income^s</u>			
~ Lowest Income Quartile	71.54	-12.22*	-5.04†
		[-24.17, -0.26]	[-10.87, 0.80]
~ 2 nd Income Quartile	47.92	-6.21	-2.19
		[-15.05, 2.63]	[-7.28, 2.89]
~ 3 rd Income Quartile	40.12	-3.98	-0.07
		[-12.34, 4.38]	[-5.82, 5.68]
~ Highest Income Quartile	30.78	-5.23	2.60
		[-11.60, 1.14]	[-4.03, 9.23]
<u>By Patient Location</u>			
~ Large Central Metro	61.65	-18.30**	-4.05
		[-29.70, -6.90]	[-11.17, 3.07]
~ Large Fringe Metro	41.12	-11.37*	-0.61
		[-20.25, -2.49]	[-10.29, 9.08]
~ Medium Metro	44.11	-4.10	-5.32

		[-17.92, 9.72]	[-14.61, 3.96]
~ <i>Small Metro</i>	41.81	1.93	11.00**
		[-7.50, 11.36]	[4.35, 17.64]
~ <i>Rural</i>	40.92	19.79**	3.99
		[5.49, 34.10]	[-6.41, 14.40]

SOURCE:

Authors' analysis of the Healthcare Cost and Utilization Project (HCUP) inpatient data 2005-2017.

NOTES:

† $p < 0.10$, * $p < 0.05$; ** $p < 0.01$; 95% confidence intervals in brackets clustered at the state level;

§ Community-level income quartiles were determined based on the median household income of patients' ZIP Code of residence.

eTable 5. Association between Medicaid Expansion and Opioid-Related Emergency Department Visits: High vs. Low Treatment Capacity States §

PERCENT CHANGE				
	(1) POST-2014 HIGH CAPACITY	(2) PRE-2014 HIGH CAPACITY	(3) POST-2014 LOW CAPACITY	(4) PRE-2014 LOW CAPACITY
<i>Opioid-Related ED Visit Rate</i>	-4.22	-0.08	-3.19	4.54
<i>(per 100,000 population per quarter)</i>	[-15.74, 7.30]	[-8.78, 8.61]	[-16.08, 9.71]	[-3.81, 12.89]

SOURCE:

Authors' analysis of the Healthcare Cost and Utilization Project (HCUP) emergency department data 2005-2017.

NOTES:

95% confidence intervals in brackets clustered at the state level;

§ High/low capacity for opioid use disorder treatment was determined based on the per-capita number of DATA-waivered physicians during the post-expansion periods comparing to the national average during the same periods.

eTable 6. Association between Medicaid Expansion and Opioid-Related Emergency Department Visits: High vs. Low Treatment Capacity States (alternative categorization) §

PERCENT CHANGE				
	(1) POST-2014 HIGH CAPACITY	(2) PRE-2014 HIGH CAPACITY	(3) POST-2014 LOW CAPACITY	(4) PRE-2014 LOW CAPACITY
<i>Opioid-Related ED Visit Rate</i>	-9.74*	-2.22	6.02	8.93†
<i>(per 100,000 population per quarter)</i>	[-19.06, -0.43]	[-10.93, 6.49]	[-5.82, 17.87]	[-0.69, 18.56]

SOURCE:

Authors' analysis of the Healthcare Cost and Utilization Project (HCUP) emergency department data 2005-2017.

NOTES:

† $p < 0.10$, * $p < 0.05$; 95% confidence intervals in brackets clustered at the state level;

§ High/low capacity for opioid use disorder treatment was determined based on the per-capita number of specialty substance use disorder treatment facilities that provided medication-assisted treatment with buprenorphine, methadone, and/or naltrexone during the post-expansion periods comparing to the national average during the same periods.

eTable 7. Association between Medicaid Expansion and Opioid-Related Emergency Department Visits

	(1) WITHOUT EXPANSION (QUARTERLY RATE PER 100,000 POPULATION)	(2) WITH POST-2014 EXPANSIONS (PERCENT CHANGE)	(3) WITH PRE-2014 EXPANSIONS (PERCENT CHANGE)
<i>All Visits</i>	29.52	-3.98 [-14.69, 6.72]	1.02 [-5.25, 7.28]
<i>By Sex</i>			
~ Female	26.65	-3.80 [-13.83, 6.23]	3.26 [-2.57, 9.10]
~ Male	32.56	-4.06 [-15.57, 7.45]	-0.93 [-7.57, 5.70]
<i>By Age Categories</i>			
~ Age <25	17.10	4.53 [-11.75, 20.81]	7.29[†] [-1.23, 15.81]
~ Age 25~44	54.70	-8.81 [-21.78, 4.17]	-3.44 [-10.77, 3.89]
~ Age 45~64	30.98	-6.45 [-19.59, 6.68]	0.10 [-5.68, 5.87]
~ Age ≥65	11.98	6.67 [-5.22, 18.57]	16.22^{***} [9.52, 22.92]
<i>By Community-Level Income[§]</i>			
~ Lowest Income Quartile	44.37	-5.78 [-21.43, 9.87]	-3.22 [-11.56, 5.11]
~ 2 nd Income Quartile	32.00	-1.71 [-10.32, 6.90]	1.25 [-4.91, 7.40]
~ 3 rd Income Quartile	26.29	-3.73 [-12.45, 4.98]	3.84 [-0.85, 8.53]
~ Highest Income Quartile	19.80	0.01 [-11.66, 11.63]	7.27^{**} [2.78, 11.76]
<i>By Patient Location</i>			
~ Large Central Metro	33.35	-4.59	-3.33

		[-17.60, 8.43]	[-15.71, 9.04]
~ <i>Large Fringe Metro</i>	28.45	-6.31	2.07
		[-19.55, 6.92]	[-3.60, 7.74]
~ <i>Medium Metro</i>	31.75	-6.76	3.88
		[-28.50, 14.97]	[-8.91, 16.67]
~ <i>Small Metro</i>	31.11	7.46	5.88
		[-7.81, 22.73]	[-7.73, 19.48]
~ <i>Rural</i>	28.27	18.80[†]	2.21
		[-0.47, 38.08]	[-9.50, 13.93]

SOURCE:

Authors' analysis of the Healthcare Cost and Utilization Project (HCUP) emergency department data 2005-2017.

NOTES:

[†] $p < 0.10$, ^{**} $p < 0.01$, ^{***} $p < 0.001$; 95% confidence intervals in brackets clustered at the state level;

§ Community-level income quartiles were determined based on the median household income of patients' ZIP Code of residence.

eTable 8. Association between Medicaid Expansion and Shares of Opioid-Related Emergency Department Visits by Expected Primary Payers^a

	(1) WITHOUT EXPANSION (SHARE OF TOTAL ED VISITS)	(2) WITH POST-2014 EXPANSIONS (PERCENTAGE POINT CHANGE)	(3) WITH PRE-2014 EXPANSIONS (PERCENTAGE POINT CHANGE)
<i>% Uninsured Share^b</i>	36.49	-20.36^{***}	-7.35^{***}
		[-24.48, -16.23]	[-11.33, -3.37]
<i>% Medicaid Share</i>	24.82	19.98^{***}	2.88
		[14.76, 25.20]	[-2.34, 8.10]
<i>% Private Insurance Share</i>	23.04	-1.15	2.61[*]
		[-3.65, 1.35]	[0.45, 4.77]
<i>% Medicare Share</i>	15.65	1.52[*]	1.85^{***}
		[0.08, 2.96]	[1.15, 2.56]

SOURCE:

Authors' analysis of the Healthcare Cost and Utilization Project (HCUP) emergency department data 2005-2017. N=1,251 state-quarter observations.

NOTES:

^{***} $p < 0.001$; ^{*} $p < 0.05$; 95% confidence intervals in brackets clustered at the state level;

a. Baseline shares were calculated by setting the policy indicators for the implementation of the post-2014 expansions and the implementation of the pre-2014 expansions to 0s; the percentage point changes of post-2014 expansions and pre-2014 expansions corresponded to the estimated regression coefficients on the policy indicators for state implementation of the post-2014 expansions and the pre-2014 expansions, respectively;

b. Patients identified as uninsured had an expected primary source of payment as self-pay, charity, or no charge; uninsured patients in some states may also include those with an expected payer of Indian Health Services, county indigent, migrant health programs, Ryan White Act, Hill-Burton Free Care, or other state or local programs for the indigent.

eTable 9. Association between Medicaid Expansion and Shares of Opioid-Related Inpatient Hospitalizations by Expected Primary Payers^a

	(1) WITHOUT EXPANSION (SHARE OF TOTAL HOSPITALIZATI ONS)	(2) WITH POST-2014 EXPANSIONS (PERCENTAGE POINT CHANGE)	(3) WITH PRE-2014 EXPANSIONS (PERCENTAGE POINT CHANGE)
<i>% Uninsured Share^b</i>	16.79	-11.10***	-1.03
		[-13.86, -8.34]	[-3.38, 1.32]
<i>% Medicaid Share</i>	27.76	10.03***	-0.81
		[6.25, 13.81]	[-2.92, 1.30]
<i>% Private Insurance Share</i>	24.43	0.98	1.39*
		[-1.58, 3.55]	[<0.01, 2.78]
<i>% Medicare Share</i>	31.02	0.09	0.45
		[-1.58, 1.75]	[-0.77, 1.67]

SOURCE:

Authors' analysis of the Healthcare Cost and Utilization Project (HCUP) inpatient data 2005-2017. N=1,863 state-quarter observations.

NOTES:

*** $p < 0.001$; * $p < 0.05$; 95% confidence intervals in brackets clustered at the state level;

a. Baseline shares were calculated by setting the policy indicators for the implementation of the post-2014 expansions and the implementation of the pre-2014 expansions to 0s; the percentage point changes of post-2014 expansions and pre-2014 expansions corresponded to the estimated regression coefficients on the policy indicators for state implementation of the post-2014 expansions and the pre-2014 expansions, respectively;

b. Patients identified as uninsured had an expected primary source of payment as self-pay, charity, or no charge; uninsured patients in some states may also include those with an expected payer of Indian Health Services, county indigent, migrant health programs, Ryan White Act, Hill-Burton Free Care, or other state or local programs for the indigent.